XIV. THE PELECYPODA OF THE CHAZY FORMATION.

By Percy E. Raymond.

The present paper is the eighth, and probably the last, of a series of papers in which the writer has dealt with the fauna of the Chazy formation of New York, Vermont, and Ontario. Six of these papers are published in these Annals, the first being entitled, "The Trilobites of the Chazy Limestone,"[1] and the others, in order, "The Chazy Formation and its Fauna,"[2] "The Gastropoda of the Chazy Formation,"[3] "New and Old Trilobites from the Chazy,"[4] and "The Brachiopoda and Ostracoda of the Chazy."[5] The present paper is the sixth.

The two papers not published in the Annals contain little which is not given in the above papers. The first, "The Fauna of the Chazy Limestone,"[6] contained a summary of the results of the study published in the Annals as "The Chazy Formation and its Fauna." The other paper, "The Trilobites of the Chazy in Vermont,"[7] is a revised and corrected compilation of the two papers on Chazy trilobites published in these Annals, and contains all the plates of both papers.

Since the writer began publishing on this fauna, two authors have made valuable contributions to our knowledge of the fossils of the Chazy. Dr. Ruedemann has published an extremely good account of the Cephalopoda[8] and Professor Hudson, in several articles, has dealt extensively and in detail with the Echinoderms. Professor Hudson's persevering work on the decomposed material in the fault on Valcour Island has been rewarded by the discovery of a great variety of very interesting specimens, and his remarkable genius for detail has enabled him to derive a great amount of information from his spoils. His most remarkable find was the nearly complete speci-

[1] Annals Carnegie Museum, Vol. III, 1905.
[2] Vol. III, 1906.
[3] Vol. IV, 1908.
[4] Vol. VII, 1910.
[5] Vol. VII, 1911.
[6] *American Journal of Science*, Vol. XX, 1905.
[7] Seventh Report Vermont State Geologist, 1910.
[8] Bull. 90, N. Y. State Museum, 1906, pp. 393–528, Pls. 1–38.

men of *Blastoidocrinus carchariœdens* which he has so carefully described and beautifully figured. The titles of Professor Hudson's papers follow, and it should be noted that his work is still incomplete, as he has still in hand a very considerable number of Cystids:

"Contributions to the Fauna of the Chazy Limestone on Valcour Island, Lake Champlain";[9] "On Some Pelmatozoa from the Chazy Limestone of New York";[10] "Studies of Some Early Siluric Pelmatozoa."[11]

Dr. Bassler, of the U. S. National Museum, several years ago undertook the study of the Bryozoa of the Chazy, but has not so far found time to complete the work. Although a considerable amount of material is available, it is, like most of the other fossils of the Chazy, in an indifferent state of preservation, and requires an unusual amount of time for its elucidation.

FIELD-WORK.

Field-work on this formation by the writer practically ceased after the summer of 1903, and I have, therefore, not so much as might be expected to say in correction of my earlier work. Fortunately I was able to spend a few weeks in 1910 and 1911 on the Chazy of the Ottawa Valley and in the region in Quebec north of the Champlain Valley, and it proves necessary to make changes in our previous views of the strata in those regions.

CHAZY IN THE OTTAWA VALLEY.

As the writer has set forth in detail elsewhere,[12] the Chazy formation of the "Geology of Canada," 1863, proved on further examination to be composed of two formations, the lower one of which is of Upper Chazy age, while the upper formation belongs to the Lowville-Black River series, and is to be correlated with the Pamelia formation in New York. This upper part corresponds to the Chazy limestone of Logan and Ells, and very nearly to the Aylmer limestone of my papers of 1905 and 1906. With the removal of this formation from the Chazy, the following fossils must be removed from the list of Chazy species: *Helicotoma whiteavsiana*, Raymond; *Sowteria canadensis*, (Raymond); *Modiolopsis brevinscula*, Billings; *Ctenodonta parvidens*,

[9] Report New York State Paleontologist for 1903–1904, pp. 270–295, pls. 1–5.

[10] Bull, 107, N. Y. State Museum, 1907, pp. 97–131, Pls. 1–10.

[11] Bull. 149, N. Y. State Museum, 1911, pp. 195–258, Pls. 1–7.

[12] *Ottawa Naturalist*, Vol. XXIV, 1911, p. 189.

Raymond; *Beyrichia? clavigera*, Jones; *Beyrichia? clavigera clavifracta*, Jones; *Isochilina ottawa intermedia*, Jones; *Isochilina labellosa*, Jones; *Leperditia amygdalina*, Jones.

An examination of the strata exposed at Grenville, Quebec, and at the mouth of the Little Rideau River a few miles below Grenville, shows that the ostracod- and trilobite-bearing limestone there is not the same as the "Chazy limestone" (Pamelia) at L'Original and Ottawa, but lies beneath the Chazy, and belongs to the Beekmantown. This necessitates the removal of the following species from the Chazy to the Beekmantown: *Bathyurus angelina*, Billings; *Leperditia canadensis*, Jones; *Primitia logani*, Jones; *Isochilina ottawa*, Jones.

This removes what had been one of the anomalies of the Chazy fauna, namely, the *Bathyurus*. *Bathyurus* is one of the strictly American genera, and its presence is usually an indication that the fauna is that of the interior sea. The other trilobites of the Chazy, on the other hand, are European or cosmopolitan genera, and the fauna as a whole is of the Atlantic facies.

At a later date, the Atlantic, or Arctic and interior faunas mingled, and we have in the Black River *Bathyurus* associated with such European genera as *Basilicus*.

CHAZY OF QUEBEC AND THE MINGAN ISLANDS.

The writer had occasion, in the summers of 1910 to 1912, to go over most of the exposures of the Chazy in the province of Quebec, except the Mingan Islands, and was surprised to find that nowhere were there exposures of strata older than the Upper Chazy of the section in the Champlain Valley.

The so-called Chazy in the section between Philipsburg and St. Armand contains no Chazy fossils, and belongs to the Beekmantown. The "Chazy slates" of Ells[13] at Mystic and vicinity are the shales and conglomerates of the Levis formation. The strata referred to the Chazy at St. Dominique belong to the upper division of the Chazy. The limestones at Caughnawaga, St. Martins Junction, Mile End, and elsewhere in the vicinity of Montreal all belong to the Upper Chazy, and have a sandstone at the base, this sandstone resting on the Beekmantown without the intervention of any strata which can be correlated with the Middle or Lower Chazy. At Joliette, fifty miles northeast of Montreal, the Chazy is a thin sandy limestone with a small fauna.

[13] Ann. Rept. Geol. Survey Canada, Vol. VII, 1896, pt. J, p. 34.

Twenhofel and Schuchert[14] have recently re-investigated the section on the Mingan Islands, and find that all the strata, which are there referable to the Chazy, are of Upper Chazy age.

It seems then, that the Middle and Lower Chazy are developed only within the limited area between Ticonderoga and the foot of Lake Champlain, and that the view that this fauna entered the continent along a channel which roughly corresponded to the St. Lawrence trough is no longer tenable. The fauna could not have come from the west, and with the St. Lawrence depression eliminated, the only other directions are the south and east. The Chazy is present in eastern Tennessee and Virginia, but is missing from the intervening states of Maryland, Pennsylvania, New Jersey, and New York as far as Ticonderoga. At the most southern exposures in New York it is the Middle and not the Lower Chazy which rests upon the pre-Chazy formation, so that the chances that the Chazy entered from that direction are very small. It would seem that the only chance for a connection with the Atlantic was from the East, directly across the Green Mountains, and the sediments of that region are, unfortunately, so metamorphosed, that it is impossible to trace the formation in that direction. There do not seem to be any reasons why the Chazy sea should not have invaded the continent from that direction, and, to the writer, such a land and sea pattern seems more natural than the long narrow fiords which have been premised by recent writers. It seems more probable that the long narrow tracts of strata now exposed are the results of the accidents of earth-movements, in which the strata have been fractured and in-faulted in long narrow zones approximately parallel to the coast line.

THE PELECYPODA.

Introduction.

Pelecypods are not very numerous in the Chazy and they are almost always badly preserved. Usually they occur as casts of the exterior, and thus do not preserve any indications of the hinge-structure or of the muscle-scars. Under such circumstances, accurate determination of the genus is practically impossible, and comparison with other known species is generally useless. Of the species herein described, only three show enough of the internal structure to be of any value,

[14] Bull. Geol. Soc. America, Vol. 21, 1910, p. 677.

and only two, or possibly three, show the true exterior outline and contours.

Modiolopsis fabaformis and *Conocardium beecheri* are rather common, and both belong to the upper division of the Chazy, and so are fairly useful as horizon-markers. Several of the species are described from unique specimens, and the *Clionychias* and *Ctenodontas*, which are relatively common, seem to have a long range, and occur at any horizon.

HISTORICAL.

The Pelecypods of the Chazy have, with the exception of the Bryozoa, been the most neglected of all its fossils. Until the appearance of Professor Hudson's paper in 1904, only five species had been described, and of these, two had not been figured. Hall in his description of the Chazy fauna in Volume I of the "New York State Paleontology" (1847) did not describe any lamellibranch, but in the "Additions and Corrections" on page 315 he briefly described *Ambonychia mytiloides*, an unrecognizable form, possibly the same as *Clionychia montrealensis*.

Billings, in an article on "Some Silurian and Devonian Fossils of Canada"[15] described *Cyrtodonta subcarinata* from the "Chazy, Birdseye, Black River limestones, and in the base of the Trenton," at Pointe Claire and numerous localities in the Ottawa Valley.

The next year, in his "Fossils of the Chazy Limestone"[16] the same author says: "The fossils [Lamellibranchiata] are rare in the Chazy limestone, yet the species seem to be somewhat numerous. I think I can make out 17 species belonging to *Ctenodonta*, *Cyrtodonta*, *Vanuxemia*, *Modiolopsis*, and probably two or three other genera. As the specimens consist mostly of casts, they must remain undescribed until better can be procured."

He then describes the following: *Modiolopsis parviuscula*, *Vanuxemia montrealensis*, *Cyrtodonta breviuscula*; and mentions *Ctenodonta nasuta*, Hall, as occurring in the Chazy.

It is significant that he does not include in this list the *Cyrtodonta subcarinata*, described by him the preceding year, and the present writer takes this to mean that on closer study he failed to identity any of the Chazy forms with the shell he described in 1858. The

[15] *Canadian Naturalist and Geologist*, Vol. III, 1858, p. 433, figs. 5–7.

[16] *Can. Nat. and Geol.*, Vol. IV, 1859.

typical specimens of that species were from the Black River (Lowville division) at Pointe Claire and Osnabruck.

The *Ctenodonta nasuta* of Billings was probably a different species from that described by Hall, and may be the *Ctenodonta parvidens* or *C. peracuta* of the present paper.

In Professor Hudson's paper,[17] two more lamellibranchs are described. These are *Modiolopsis subquadrilateralis* and *Cyrtodonta ? lamellosa*, both small and rare species, so far found only at the type-locality.

In 1905 the writer[18] described, without figures, thirteen species of pelecypods, which he supposed were from the Chazy, but further study has shown that two of them were from the overlying formation. In 1906[19] he added four more species, also without illustrations.

In 1908, Dr. J. F. Whiteaves[20] described several pelecypods supposed to have come from the Chazy, but recent field-work has shown that most of these, including all his new species, were derived from the Pamelia. In this paper, *Modiolopsis parviuscula* and *Cyrtodonta breviuscula* were figured for the first time.

Sub-Kingdom **MOLLUSCA** Linnæus.

Class *PELECYPODA* Goldfuss.

Order PRIONODESMACEA Dall.

Family CTENODONTIDÆ Dall.

Genus **Ctenodonta** Salter.

1. **Ctenodonta peracuta** Raymond. (Plate XXIX, figures 1–3.)

Cf. *Nucula levata* HALL, Paleontology New York, Vol. 1, 1847, p. 150, figs. 1*f–i*.

Ctenodonta levata RAYMOND, Bulletin of American Paleontology, Vol. III, 1902, No. 14, pp. 14, 15, 19. (In lists.)

Ctenodonta peracuta RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 371.

Since this species was originally described, a fragment of a free shell has turned up in the loose material in the fault on Valcour

[17] Report of the N. Y. State Paleontologist for 1903 (1904), p. 286.

[18] *American Journal of Science*, Vol. XX, (Ser. 4), 1905, pp. 371–374.

[19] ANNALS CARNEGIE MUSEUM, Vol. III, 1906, pp. 577, 578.

[20] *Ottawa Naturalist*, Vol. XXII, 1908, p. 105.

Island. All the other specimens, which are fairly numerous, are casts of the exterior of single valves. In the present paper, the shorter and higher end of the shell is called the front of *Ctenodonta*, while in the original description, the longer end, toward which the beaks point, was considered the front.

Description.

Shell small, depressed convex, thickest at the umbos, longer than high, the beak situated at about one-third the length. The posterior end is somewhat drawn out, as in *Ctenodonta nasuta* Hall. Greatest convexity at the umbo, the anterior slope steep, posterior slope very gradual. Both slopes to the hinge abrupt, but that to the basal margin gentle. The interior of a right valve shows the teeth in a gently curved, uninterrupted series, nine teeth in front, and seven behind the beak. A large specimen is 12 mm. long and 9 mm. high.

This species resembles those specimens of *Ctenodonta levata* (Hall) which are represented by figures 1*f* to *i* of the plate cited in the synonymy we have given, but are unlike figures 1*a* to 1*c*. There seem to be fewer teeth on the hinge than in *C. levata*.

Locality.—Rather common in the trilobite layers of the Middle Chazy on Valcour Island, and at the same horizon at Crown Point. Also in the Upper Chazy on Valcour Island.

2. **Ctenodonta dubiaformis** Raymond. (Plate XXIX, figure 6.)

Ctenodonta dubiaformis RAYMOND, American Journal of Science, (Ser. 4), Vol. XX, 1905, p. 371.

The outline of this species resembles the smaller specimens of *Ctenodonta dubia* figured by Hall, and it plainly belongs to the same group. It is, however, higher in proportion to the length.

Description.

Shell small, moderately convex, beak sub-central. Greatest convexity at the umbo, the slope from it to the base being nearly flat. Basal margin nearly straight. Posterior end nasute, and a little longer than the anterior end, which is regularly rounded.

All the specimens are casts, without trace of hinge teeth, muscle scars, or surface markings. The largest specimen is 19 mm. long and 10.5 mm. high. Another is 17 mm. long and 9 mm. high.

Locality.—Sloop Bay, Valcour Island, in the middle of the Chazy.

3. **Ctenodonta ? bidorsata** Raymond. (Plate XXIX, figures 4, 5).

Ctenodonta? bidorsata RAYMOND, Annals Carnegie Museum, Vol. III, 1906, p. 577.

This small shell has something of the general shape of a *Ctenodonta*, and for lack of knowledge of what it really is, it is placed in that genus. The specimen shown in figure 4 of the plate has somewhat the appearance of a *Pterotheca expansa*, though it has no keel.

Description.

Shell small, longer than high. Hinge back of beak nearly straight, rather long. End of shell in front of beak short and broadly rounded. Lower margin gently curved. Posterior end short and rather acute. The internal cast is marked by two narrow sinuses which radiate from the beak. The distal end of the anterior one is nearly opposite the beak, while the posterior one runs diagonally across to the posterior-ventral angle of the shell. In front of the anterior sinus and behind the posterior one there is a narrow ridge. The valves are only slightly convex, highest at the umbo, and concave along the hinge margin. One specimen is 11 mm. long and 7 mm. high.

Locality.—A rare species in the trilobite layers of the Middle Chazy at Sloop Bay on Valcour Island, N. Y.

Family LEDIDÆ Adams.

Genus **Clidophorus** Hall.

4. **Clidophorus obscurus** Raymond. (Plate XXIX, figure 9).

Clidophorus obscurus RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 372.

Description.

Shell small, longer than high, not very convex. Basal margin nearly straight, anterior end rounded, posterior end narrow. In front of the beak the cast shows a short clavicular impression which extends about half the distance to the lower margin. The single specimen is 6 mm. long and 4 mm. high.

Locality.—Trilobite layers, Middle Chazy, Sloop Bay, Valcour Island, N. Y.

Family CYRTODONTIDÆ Ulrich.

Genus **Cyrtodonta** Billings.

5. **Cyrtodonta solitaria** Raymond. (Plate XXIX, figure 15).

Cyrtodonta solitaria RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 373.

Only a single right valve of this species has been found. It is roughly triangular, the beak a little behind the anterior end, and the hinge line short. The anterior end is narrow and rounded, the basal margin long and straight, making an angle of about 45° with the hinge. Posterior margin regularly rounded. Shell only moderately convex, the slope to the posterior margin gradual and that to the front nearly flat. Surface marked by concentric lines of growth. The length is 15 mm. and height 12.5 mm. This is a larger, more compressed and smoother shell than *C. lamellosa*, Hudson.

Locality.—From the Lower Chazy at the ledge in the pasture at Tracy Brook, Chazy, New York.

6. **Cyrtodonta lamellosa** Hudson. (Plate XXIX, figure 16.)

Cyrtodonta? lamellosa HUDSON, Report of the New York State Paleontologist for 1903 (1904), p. 287, Pl. 4, figs. 10–13.

This is a small shell with moderately convex valves, and very strong lamellæ of growth. For a detailed description, Professor Hudson's paper should be consulted.

7. **Cyrtodonta scala** Raymond. (Plate XXIX, figure 14.)

Cyrtodonta scala RAYMOND, Annals Carnegie Museum, Vol. III, 1906, p. 578.

Shell small, strongly convex, the anterior lobe small and depressed. Posterior margin semicircular in outline. Slope from the umbo to the posterior margin more gentle than that to the anterior. One specimen is 11 mm. long and 9 mm. high.

Locality.—This species has been found only in the trilobite layers at Sloop Bay, Valcour Island, where it is rare.

Genus **Vanuxemia** Billings.

8. **Vanuxemia limbata** Raymond. (Plate XXIX, figures 10, 11.)

Ctenodonta limbata RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 371.

Outline nearly circular, the beak terminal, the shell strongly convex and rounded. Greatest convexity near the middle of the valve; all slopes steep. The cast shows a few faint lines of growth.

The largest specimen is 10 mm. long and 10 mm. high. A smaller one is 8 mm. in either dimension.

Locality.—All the specimens are from the trilobite layers at Sloop Bay, Valcour Island, New York.

Family AMBONYCHIDÆ Miller.

Genus **Clionychia** Ulrich.

9. **Clionychia montrealensis** (Billings). (Plate XXIX, figures 18–24.)

Vanuxemia montrealensis BILLINGS, Canadian Naturalist and Geologist, Vol. IV, 1859, p. 447, figs. 25, 26; Geology of Canada, 1863, p. 131, figs. 61a ,61b.
Clionychia montrealensis WHITEAVES, Ottawa Naturalist, Vol. XXII, 1908, p. 107.

Description.

Shell of medium size, sub-triangular in outline, beaks terminal and directed forward. Umbones narrow and depressed. The greatest convexity of the shell is along the middle of the valve. The anterior slope is somewhat more abrupt than the posterior, and the posterior side is drawn out into a short wing. The posterior margin is gently convex, and makes an angle of about 100° with the hinge. The basal margin is nearly semicircular, and the anterior margin straight or slightly concave.

One specimen is 12 mm. long and 14 mm. high, and another 13.5 mm. long and 15 mm. high.

Locality.—This is one of the commoner species in the middle and Upper Chazy at Valcour Island and Chazy, New York, and Montreal, Canada. The types are a small right valve and a larger left valve on a small piece of limestone from Montreal.

10. **Clionychia marginalis** Raymond. (Plate XXIX, figures 25, 26.)

Clionychia marginalis RAYMOND, American Journal of Science, (Ser. 4), Vol. XX, 1905, p. 373.

Most specimens of this species are larger than those of *C. montrealensis*, and can readily be distinguished from that species by the almost perpendicular front slope, the shorter hinge line and the less oblique axis of the shell.

Description.

Both valves moderately convex, the umbones somewhat depressed, but increasing rapidly in height, the greatest thickness of the valves being at about one-third the distance from the beak to the lower margin. Hinge line short. The posterior margin is broadly rounded, the lower margin semicircular. The front is almost straight. The greatest convexity is along a line parallel to the front. The posterior

and lower slopes are gentle, but the front slope is abrupt, making an angle of almost 90° with the plane of union of the valves. The surface is marked by very fine concentric lines of growth.

One specimen is 20 mm. long and 26.5 mm. high.

Locality.—This species is found in the Lower Chazy at Chazy and Valcour Island, New York.

Genus **Ambonychia** Hall.

11. **Ambonychia curvata** Raymond. (Plate XXIX, figures 27, 28; Plate XXX, figures 1–3.)

Ambonychia? curvata RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 373.

One of the most common pelecypods in the Chazy is a large form which appears to belong to the genus *Ambonychia*, but as all the specimens so far found are internal casts, there is no evidence as to whether or not it had the characteristic radial striæ of that genus.

Description.

Shell large, both valves very strongly convex, especially along the region at the front and middle of the valves. Beaks small, incurved, directed a little forward. Anterior slope abrupt and overhanging. Posterior and basal slopes rather steep. Posterior wing short. The posterior margin is slightly convex, almost straight, the anterior margin rounded.

The length and height are nearly equal. A large specimen is 27 mm. long and 26 mm. high. Another is 43 mm. long and 39 mm. high. A small one is 10 mm. long and has the same height. The species is easily recognized by the curved anterior margin and great convexity. It is possible to confuse *Clionychia montrealensis*, *C. marginalis*, and *Ambonychia curvata*, but *C. montrealensis* has the greatest convexity along the middle of the valve; in *C. marginalis* it is along the anterior margin, and in *Ambonychia curvata* the line of greatest convexity is along a curve the convex side of which is forward. *Clionychia montrealensis* also has much more narrow and depressed beaks than the other two species.

Locality.—All through the Chazy, especially in the upper part, at Chazy, Valcour Island, and Sloop Island, New York.

Family CONOCARDIIDÆ Neumayr.

Genus **Conocardium** Brongniart.

12. **Conocardium beecheri** Raymond. (Plate XXX, figures 4–10.)

Conocardium beecheri RAYMOND. American Journal of Science (Ser. 4), Vol. XX, 1905, p. 374.

One of the unexpected discoveries made while collecting at Valcour Island was a small *Conocardium* which was found in great numbers on Sloop Island, a rock about one-fourth mile east of Valcour Island. The writer has since found it on the main island of Valcour, and at Chazy but it is very rare at both these places. Twenhofel and Schuchert recently found it on the Mingan Islands.[21]

Conocardium beecheri is the oldest representative of the genus. *Conocardium immaturum* Billings, from the Black River at Pauquette's Rapids on the Ottawa River, is of about the same size as our specimens, but differs from them in having a broader and shorter anterior wing, and a smooth posterior wing. The only other Ordovician species is *Conocardium* (*Pleurorhynchus*) *antiqua* Owen, from the Ordovician at Lower Fort Garry, on the Red River of the North. This species is not well known, as no description has been published, and only a single imperfect specimen figured.

Eopteria typica and *Euchasma blumenbachia*, both described by Billings, have somewhat the form of *Conocardium*, but a different hinge-structure. They are not well known. Dall, in the American edition of Zittel's Paleontology, places these genera with doubt in the family *Cardiolidæ*. They are believed by others to be Crustacea.

Description.

Shell small but robust, with long anterior and short posterior wings. The region of greatest convexity is along the mid-line of the shell, the convexity decreasing gradually to the anterior wing and rather abruptly to the posterior one. The anterior wing is long, with a straight lower margin. The posterior wing is short and narrow, joining the shell at a large angle. The surface is marked by seven or eight large plications on the anterior wing, fifteen to twenty smaller ones on the body of the shell, and three or four very large ones on the posterior wing.

[21] *Bull. Geol. Soc. America*, Vol. 21, p. 692, 1910.

One specimen is 6.5 mm. long and 5 mm. high, while a second is 6 mm. long and 4 mm. high.

Locality.—Found at the base of the Upper Chazy on Sloop Island, east of Valcour Island, N. Y. Also at the same horizon on Valcour Island and at Chazy, New York. Also in the Upper Chazy at the Mingan Islands, Canada.

Family MODIOLOPSIDÆ Fischer.

Genus **Whiteavsia** Ulrich.

13. **Whiteavsia? undata** Raymond. (Plate XXX, figures 23, 24.)

Whiteavsia? undata RAYMOND, Annals Carnegie Museum, Vol. III, 1906, p. 578.

Shell rather small, robust, the upper and lower margins sub-parallel. Beak elevated, incurved, small. A broad, shallow depression extends from the umbo to the basal margin, giving the shell a flattened appearance. Anterior margin nearly straight, meeting the hinge in almost a right angle. Posterior margin rounded. From the umbo an oblique ridge extends to the lower anterior angle of the shell, and the slope from this ridge to the front is steep.

The length is 25 mm. and the height 12.5 mm.

Locality.—A very rare shell in the trilobite layers, Sloop Bay, Valcour Island, New York.

14. **Whiteavsia ? expansa** Raymond. (Plate XXX, figure 20.)

Whiteavsia? expansa RAYMOND, Annals Carnegie Museum, Vol. III, 1906, p. 578.

Shell oval in outline, only moderately convex, with a strong ridge running diagonally from the beak to the lower posterior angle. The slope from this ridge to the hinge and posterior margin is abrupt and rounded. To the basal margin the slope is gradual and almost flat. The internal cast shows a small but distinct anterior muscle scar and strong concentric growth lines, which are especially prominent on the umbonal portion of the shell.

An average specimen is 14 mm. high and 19 mm. long.

Locality.—A rare species in the trilobite layers of the Middle Chazy at Valcour Island, New York.

Genus **Endodesma.**

15. **Endodesma tranceps** Raymond. (Plate XXX, figures 17–19.)

Cyrtodonta tranceps RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 372.

This is one of the commoner species of the Middle Chazy. All the specimens are casts of the exterior. The change in generic reference is due to Mr. Ulrich, who has seen some of the typical specimens.

Description.

Shell roughly rectangular in outline, strongly convex at the umbo and along a ridge which runs diagonally across the shell to the lower posterior angle. In front of this ridge there is usually a slight depression running from the umbo to the middle of the lower margin. The posterior margin is regularly rounded, and the basal margin straight or slightly concave. The anterior end extends a short distance in front of the beak. The slope to the hinge is flat and rather steep. The slope to the front and base is gently convex and more gradual than that to the hinge. The surface is marked by fine concentric lines.

Locality.—Rather common in the middle Chazy at Valcour Island, New York.

Genus **Modiolopsis** Hall.

16. **Modiolopsis fabaformis** Raymond. (Plate XXX, figures 12, 13.)

Modiolopsis fabaformis RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 374.

This little shell, which much resembles the *Modiolopsis faba* of the Trenton, is the one pelecypod which is common in the upper layers of the Chazy at Valcour Island. In the upper one hundred feet of the section at that point it is quite abundant in connection with *Camarotœchia plena*. It is related only to *Modiolopsis exanimis* of the Chazy species of the genus.

Description.

Shell small, narrow, thick, with a strong ridge extending from the umbo to the lower posterior angle. In front of this ridge is a deep depression which continues to the middle of the ventral margin, making that margin sinuate. The anterior ear is small and convex; anterior margin narrowly rounded. Posterior margin broadly rounded, not oblique as in *Modiolopsis parviuscula*. The surface is marked by numerous lines of growth. This is not the *Modiolopsis fabœformis* of Whiteaves,[22] which is a shorter and higher shell.

Locality.—Common in the Upper Chazy on Valcour Island, New York.

[22] Ottawa Naturalist, Vol. XXII, 1908, p. 110, pl. III, figs. 7–9.

17. **Modiolopsis exanimis** sp. nov. (Plate XXX, figure 11.)

This species is very like the preceding, but is so much shorter and higher that it cannot be united with it.

Locality.—A rare species in the Upper Chazy on Valcour Island, New York.

18. **Modiolopsis parviuscula** Billings. (Plate XXX, figures 14, ? 15, 16.)

Modiolopsis parviuscula BILLINGS, Canadian Naturalist and Geologist, Vol. IV, 1859, p. 446; WHITEAVES, Ottawa Naturalist, Vol. XXII, 1908, p. 106, pl. III, figs. 1, ? 2.

This species which was described by Billings in a single sentence of less than two lines, and not figured, must rest on the single Chazy specimen now remaining at Ottawa. This specimen is on a bit of fine-grained, dirty-looking limestone from Cornwall, Ontario, and in the same bit of matrix there are several fragments of *Camarotœchia plena*. The *Modiolopsis* is apparently crushed and flattened, and shows nothing more than the general outline. The distinctive feature about the specimen is that the posterior basal angle projects beyond the upper angle or any part of the posterior end of the shell. In this feature the shell is like *Modiolopsis modiolaris*, to which Billings compared it, and by the same feature it may be distinguished from all other species of *Modiolopsis* in the Chazy or Aylmer formations.

Description.

The type, a right valve, is small, with short hinge and semicircular anterior end. The ventral margin is nearly straight, and much longer than the hinge. The posterior margin is oblique, the posterior angle abruptly rounded, while the posterior dorsal angle is very obtuse. A low broad ridge extends from the umbo to the lower posterior angle, and the shell slopes gently in all directions from it. The surface is marked by numerous concentric lines of growth.

Locality.—From the Upper Chazy at Cornwall, Ontario.

What appears to be the same species occurs in the lower part of the Pamelia formation at Aylmer, and a very good specimen, collected by T. W. E. Sowter at that locality, is figured (Pl. XXX, figs. 15, 16).

19. **Modiolopsis subquadrilateralis** Hudson.

Modiolopsis subquadrilateralis HUDSON, Report of the N. Y. State Paleontologist for 1903 (1904), p. 286, Pl. 4, figs. 8, 9.

This is a small shell, with smooth, convex valves. It is described in detail in Professor Hudson's recent paper.

20. **Modiolopsis sowteri** Raymond. (Plate XXX, figures 21, 22.)

Modiolopsis sowteri RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 374.

One of the most common and best preserved pelecypods occurring in the Aylmer formation is a species of *Modiolopsis* to which I gave the specific name, *sowteri*, in honor of T. W. E. Sowter, Esq., of Aylmer, Quebec, who has given much close attention to the study of the Aylmer formation, and who collected a large part of the many new species which have been described from his native town.

Description.

Shell of medium size for the genus, rather convex, with a strong ridge running from the beak to the lower posterior angle. Toward the front is a slight depression, running from just ahead of the beaks a little backward to the basal margin. In front of the beak is a very deeply impressed anterior muscle scar, which on the internal cast, is represented by a rounded, conical elevation. The posterior scar is large, and close to the hinge line. One specimen is 51 mm. long and 28 mm. high; another 33 mm. long and 20 mm. high.

Locality.—From the Aylmer sandstone (Upper Chazy), about sixty feet above the high water mark of Lake Deschenes, at Aylmer, Quebec. Collected by T. W. E. Sowter.

APPENDIX.

The following species were described as coming from the Chazy, but really belong to the overlying formation, the Pamelia, which is of Lower Black River age.

21. **Ctenodonta parvidens** Raymond. (Plate XXIX, figures 7, 8.)

Ctenodonta parvidens RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 373; WHITEAVES, Ottawa Naturalist, Vol. XXII, 1908, p. 113, pl. 3, fig. 16.

One of the commonest species in the shale and sandstone of the

Pamelia formation at the Hogs Back, near Ottawa, is a *Ctenodonta*, which is much larger than *C. peracuta*, and which differs from *C. dubiaformis* in not having the beaks centrally located. There are some points in which the shell agrees with *C. nasuta* (Hall), but the shape of the posterior end is different, and the teeth are smaller and more numerous.

Description.

Shell oval in outline, usually flattened, but specimens from the harder layers show a considerable convexity below the umbo, with regular slopes to the anterior, posterior, and ventral margins. The anterior and posterior margins are regularly rounded, and the posterior end is a little narrower than the anterior. The cast shows the impressions of numerous very fine teeth on the hinges, but the number cannot be counted, as the beak is always flattened down upon the hinge. One specimen shows five teeth on the posterior side of the beak and another shows seven. The surface is marked by numerous concentric lines of growth.

Locality.—In the shale and sandstone of the Pamelia formation at the Hogs Back, near Ottawa, Ontario.

22. **Cyrtodonta breviuscula** Billings. (Plate XXIX, figure 17.)

Cyrtodonta breviuscula BILLINGS, Canadian Naturalist and Geologist, Vol. IV, 1859, p. 446; WHITEAVES, Ottawa Naturalist, Vol. XXII, 1908, p. 107, Pl. 3, fig. 3.

The type of the species is a small left valve in a bit of almost pure quartz sandstone. The type has been unique until recently, when the writer rediscovered the original locality "three miles east of Ottawa," on a road leading toward the river just beyond Robillard's quarries.

Description.

Shell small, nearly as high as long. Hinge short, straight. Beak near the anterior end of the shell, overhanging the hinge margin. Anterior lobe small, semicircular. Basal margin straight, posterior margin gently curved, oblique. Valves rather thick, the highest point a little back of the umbo. A strongly elevated ridge extends from the umbo to the posterior ventral angle. The type is 12.5 mm. long and 10 mm. high. A larger specimen is 20 mm. long and 15 mm. high.

Locality.—The type-locality is just below the quarry in the Pamelia

limestone on the road running from Montreal Road to the Ottawa River, three miles east of Ottawa, where there is an outcrop of white sandstone by the roadside. The spec es also occurs in the limestone of the Pamelia all around Ottawa.

23. **Sowteria canadensis** (Raymond). (Plate XXIX, figures 12, 13).

Whitella canadensis RAYMOND, American Journal of Science (Ser. 4), Vol. XX, 1905, p. 373.

Sowteria canadensis WHITEAVES, Ottawa Naturalist, Vol. XXII, 1908, p. 112, Pl. 3, figs. 13–15.

Whiteaves's description of the genus is as follows:

Shell rather small, equivalve, moderate'y convex, sometimes tumid and always most prominent on the oblique posterior umbonal slope; subtrapezoidal in marginal outline, a little longer than high, and very inequilateral. Posterior area defined by an abrupt inflection of each valve at and behind the subangular umbonal declivity.

"Test unknown; in casts of the interior the greater part of the surface is marked by a few large concentric rib-like folds, but the posterior area of both valves is nearly or quite smooth. Hinge dentition and muscular impressions unknown."

Specific Characters.

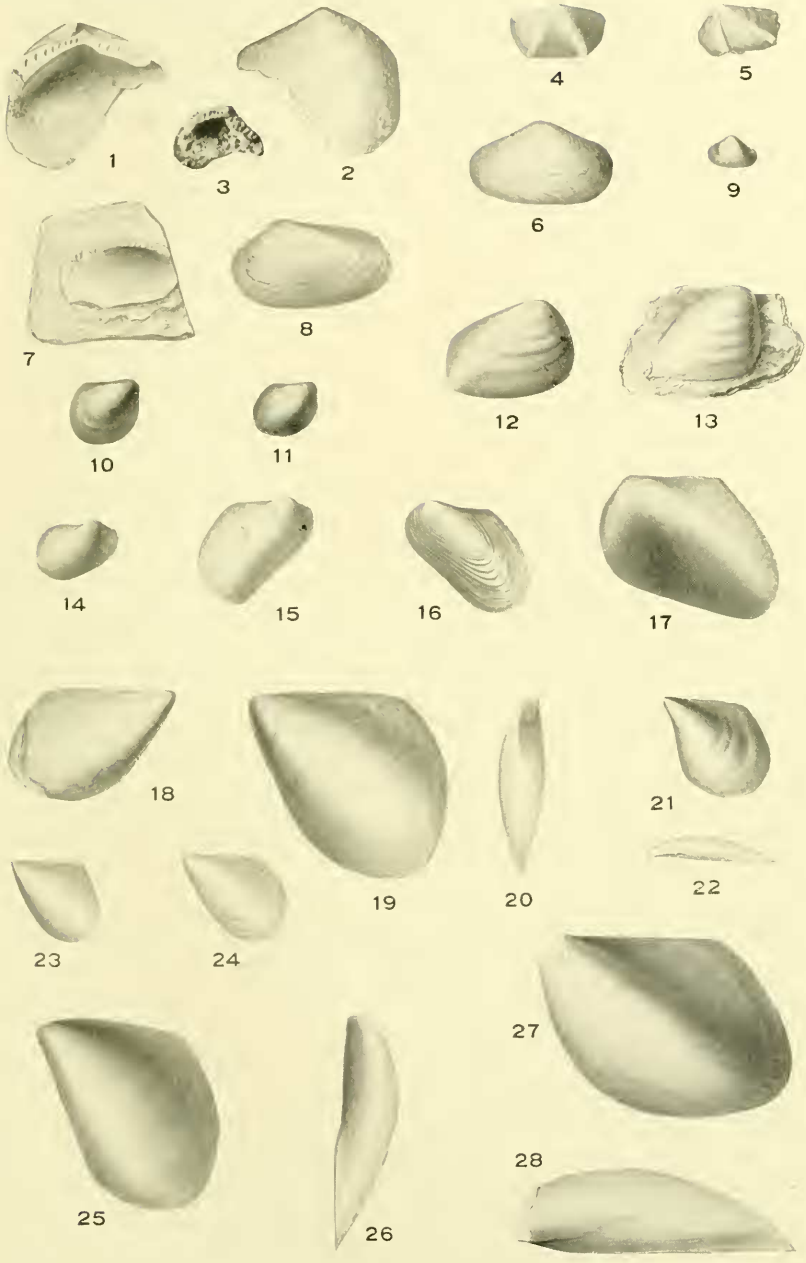
"Anterior portion of each valve very short, in some specimens truncated almost vertically at its extremity, in others faintly concave under the beaks above, and rounded at or below the mid-height; posterior portion moderately its extremity obliquely subtruncate above and narrowly rounded below. Superior border and ventral margin nearly straight or very gently convex; beaks nearly or quite terminal."

Locality.—Rather common in the sandstone of the Pamelia at Aylmer, near Wright's brickyard above Tetreauville, and at the same locality east of Ottawa as *Cyrtodonta breviuscula.*

EXPLANATION OF PLATES.

PLATE XXIX.

1. *Ctenodonta peracuta* Raymond. A small, imperfect, but free, right valve, × 4.
2. The same specimen, exterior view, × 4.
3. The same specimen, a photograph of the interior.
4, 5. *Ctenodonta ? bidorsata* Raymond. Two specimens. Natural size.



Pelecypoda of the Chazy.